Appendix G. Potential Restoration Projects

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
1	Westchester Lagoon outlet	Fish passage improvements	Poorly operating fish ladder	Covered in detail in section 3 of this environmental assessment.	
2	Near lagoon outlet	Create wetlands	Past construction	None needed at this time	No project
3, 3A	Near lagoon outlet	Enlarge ponds	Past construction	Not needed as ponds will be incorporated into fish passage improvements	No project
4	Westchester Lagoon	Construct islands	Area flooded by creation of the lagoon	Construct islands. Covered in detail in section 4 of this environmental assessment.	
5	Spenard Road parking area	Bank improvements	Bank degradation caused by people feeding geese	Project completed in 1999	No project
6	Creek mouth at Westchester Lagoon	Upper basin of the three lagoons in Westchester Lagoon. The basin water depth appears to be becoming shallower and the basin is transforming from open water into a marsh.	Sediment has accumulated in the upper portion of the basin, filling the old channel bed. Accumulation may be progressing upstream in the creek channel as deposition occurs at the lagoon/creek interface. The deposition in this area is a natural process and cannot be avoided. The rate of accumulation will depend on the sediment recruitment rate in Chester Creek downstream of Hillstrand Pond, including the North Fork. Sediment is a combination of natural erosion of the creek bank, excessive erosion of destabilized areas, and street sand from storm drains.	Dredging of the area is possible. This would locally deepen the channel and provide new area for the sediment to accumulate. Dredging will be required again in the future when the area fills with sediment. The sediment may have high concentrations of hydrocarbons and heavy metals and may require special disposal techniques. A sediment trap could be constructed in the creek just upstream of the lagoon. A trap will require regular cleaning but will be less costly than dredging to maintain as it is designed to be cleaned. The accumulated sediment may require special disposal methods as it may have high concentrations of hydrocarbons and metals. Sediment source removal will reduce accumulation rates. This alternative will also help the MOA meet its NPDES storm water	Do no dredging of the area. Let the upper lagoon progress into a marsh naturally and the channel become constrained by this process. Institute sediment reduction measures upstream. Stabilize excessively eroding areas upstream to reduce sediment supply.

Appendix G. Potential Restoration Projects

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
				discharge permit stipulations.	
7	Arctic Boulevard culvert outlet	Deposition of sediment in the culvert has reduced the flood capacity of the structure. Sediment deposition in the creek channel upstream of the culvert is causing the channel to widen and erode the banks with shallow water depths. The area has lost channel complexity and associated habitat quality.	The boulders placed at the outlet of the culvert cause a backwater to form within and upstream of the culvert. This backwater has caused sediment deposition in and upstream of the culvert. The process will continue upstream until a stable slope is formed. The backwater effect will continue upstream for some distance and will reduce habitat quality in this reach.	The boulders were initially placed to address a concern that the culverts were a high velocity area that could block fish passage. Restoration of this area will require removing the boulders to allow sediment transport through this reach. Once the boulders are removed the stream will move the accumulated sediment and restore channel complexity over time. The boulder removal must address possible fish passage concerns during the design process.	Model the culvert over a range of flows to determine its ability to pass fish without the boulders in place. Select a removal technique or replacement option that will pass sediment while not creating a fish passage problem and maintaining flood capacity. Remove boulders and construct improvements as required (a vortex rock weir). Let the accumulated sediment pass.
7A	Arctic Boulevard culvert	Backwater upstream of culvert and high velocities in culverts during high flows. Lack of habitat in culvert.	Culvert beneath Arctic Boulevard has less conveyance area than open channel.	Replace existing culvert with a culvert with sufficient width to match existing stream.	Culvert replacement
8	Valley of the Moon Park	Stream bank trampling. Stream channel sediment accumulation.	This is a high use area due to the adjacent park. Trampling is concentrated in a few areas. Those areas are being transformed into beaches and provide good access for people to the creek. Sediment accumulation is from the Arctic Boulevard culvert.	Limited planting could be done along the stream bank in a few locations. The high use areas at the beaches should be left as they provide access with the minimum of disturbance to the creek. Sediment accumulation will be addressed with the Arctic Boulevard culvert work (Project 7).	Limited planting through coordination with volunteer groups. Build the Arctic Boulevard culvert improvements (Project 7).
8A	Private lot on the south bank of the creek across from Valley of the Moon Park	Rock used to line channel bank. Lawn area to water's edge.	Maximization of lawn space by the property owner	Work with property owners to remove rocks and install higher habitat value methods for providing creek bank stability. Plant an area next to the creek with shrubs and trees to shade the creek, and provide bank stability and habitat values.	Remove rocks and install log and boulder revetment. Plant area on top of revetment with riparian vegetation.

Appendix G. Potential Restoration Projects

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
9	C Street bridge	Channel widening and bed aggradation with loss of habitat.	The channel has been widened to accommodate construction of storm drain outfalls and a bike underpass. The entrenchment of the upstream channel ends at this section, causing sediment transport capacity to be reduced at higher flows. The local slope may have been reduced also during bridge and underpass construction further increasing sediment deposition.	The sediment transport capabilities of the channel needs to be restored to this area. This will require dredging a thalweg channel on the south side of the stream, filling to create a floodplain bench on the north side of the stream, and narrowing the channel to match upstream and downstream channel widths.	Survey and model area to determine required channel dimensions to maintain sediment transport. Dredge channel thalweg. Construct floodplain riparian area on north side of the channel to narrow channel to consistent channel width. Add in-channel habitat structures as appropriate that will also maintain sediment transport. Plant bank areas to restore riparian vegetation.
9A	East of C Street	Inadequate oil-grit separator (OGS). Excess sediment and oil are input into Chester Creek.	The current system drains 332 acres of urban area and passes it through an existing, and very old, corrugated metal pipe (CMP) oil-grit separator (OGS) and discharges to Chester Creek on its north bank, just east of C Street. The existing OGS is deteriorating from significant levels of corrosion, and cannot adequately treat moderate volumes of storm water runoff frequently encountered. The existing outfall terminates at Chester Creek through two 24 in. CMP arch pipes mounted in a concrete headwall. Both outfall pipes are also undergoing severe corrosion, allowing high velocity storm water to breach the pipe walls and undermine surrounding soil, and wash the soil into the creek. Due to corrosion, all storm drainage is	Replace the existing OGS with a new one with improved features and reconstruct an outfall channel to meet the flow requirements.	The existing facilities would be replaced with an improved OGS. A new 48 in. diameter outfall pipe would direct water from the new OGS to a 6 ft wide by 20 ft long lined channel, which would breach the north bank of Chester Creek approximately 20 ft upstream of the existing outfall. New corrugated polyethylene pipe would be installed. The existing outfall headwall would remain in place to minimize disturbance of the outfall channel. The old outfall pipes would be removed and the cavities would be filled. A vegetated creek bank would be placed along the wall where it meets the outfall slough and potentially along one side of the slough. Material for this new bank would be salvaged from the existing bank at the new outfall location. The old outfall channel would have additional vegetation

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
			currently routed through the western pipe. In this configuration, the outfall has deficient flow capacity, meaning that the upstream storm drain has to pressurize in order to convey original design flows. Thus, storm water will tend to back up the storm drain system and outfall flow will reach very high velocities, causing material captures in the OGS to be washed out and also scour the existing outfall channel.		added to its banks to create a side-water channel in the creek.
10	Chester Creek greenbelt south of Mulcahy Park	Abandoned channel in greenbelt.	Creek was rerouted around the channel in the 1970s.	Reconnecting the channel is not possible. The channel does not exist in the greenbelt in a form that is usable. It also has a higher bed elevation than the existing channel.	None
10A	Cordova Street bike trail bridge	Bank erosion upstream of the bridge	Sharp bend is a high erosive force area. The bank has limited vegetation and below the grass mat is a rubble pile of concrete debris and gravel. The bank has low stability and is easily eroded.	The concrete that has fallen into the creek should be removed. It is focusing the creek's energy on the bank and helping to destabilize the area. The bank needs to be stabilized to eliminate the erosion and to protect the bike trail and bridge. This will also improve fish habitat and decrease sediment supplied into the creek. Planting the banks with trees will enhance the stability of the bank as well as provide habitat values for fish.	Remove concrete that has already fallen into the stream. Construct a root wad revetment either side of the existing birch tree and immediately downstream of the cottonwood trees at the beginning of the curve. Revegetate the area.
11	Fairbanks Street	Bank erosion	This is a common crossing for children, which keeps vegetation from becoming thickly established. The bank materials	The bank toe should be stabilized to reduce the erosion rate. Bank materials should be removed and replaced with more sandy and	Install a log at the bank toe to reduce erosion. Construct log steps. Remove and replace the top foot of

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
			are clean gravel and highly susceptible to erosion and not good for developing deep root systems in plants.	silty materials that promote vigorous plant growth. A stairs built of logs placed into the creek bank should be considered to concentrate the crossing activity in one area and control its effects.	bank material with better soil. Plant banks with riparian trees and shrubs.
12	Seward Highway culvert downstream end	Unstable banks and erosion	The storm drain outlet on top of the creek culvert has eroded the stream bank and keeps the area unstable. A past trail widening project installed the chain link fence and the steep bank above it. The bank is too steep for vegetation to become established. High outlet velocities in the creek culvert during flood events cause erosion.	The gabion wall on the south side of the creek is beginning to fail and should be reinforced. It protects the steep bank from the full force of the creek at flood stages. The north bank of the creek (trail side) should be replaced with a root wad and boulder revetment.	Construct root wad revetment. Terrace and plant bank. Construct structure to divert entire storm drain to other side of the creek culvert. Install boulder erosion protection to direct storm water flows into creek.
13	Seward Highway culvert upstream end	High water velocities create a probable fish passage barrier at the inlet end of the culvert.	This problem was caused because the culvert under the Seward Highway was extended an additional 20 ft. The additional culvert segment was installed at a steeper angle than the original portion of the culvert. The steeper culvert angle causes the high velocities at the culvert entrance.	This project would remove the steeper segment and reset it to a shallower slope to match the remaining culvert barrel. This will allow the stream to downcut upstream of the culvert until a stable bed slope is established. To control bed lowering, a series of vortex rock weirs would be installed in the channel upstream of the culvert. These will control bed scour while maintaining sediment transport in the creek.	Remove and reset the upstream end of the culvert. Reconstruct creek banks. Install vortex rock weirs.
13A	Seward Highway culvert	Backwater upstream of culvert and high velocities in culvert during high flows.	Culvert has less conveyance area than an open channel.	Chester Creek presently flows under the Seward Highway in a 200 ft long, 7 ft diameter culvert. This culvert is paralleled by a 10 ft 10 in. x 9 ft 6 in. culvert for the Chester Creek trail. Replacement of this culvert with a bridge would eliminate backwater and high	This project would replace the creek culvert and trail culvert with a bridge. If this project were constructed, swapping the locations of the creek and the trail should be considered. This would put the creek back into its original alignment, the trail would buttress

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
				velocity problems. This would allow totally unrestricted fish passage and would also reclaim this area as rearing habitat.	the existing steep south bank, and additional headroom would be provided for the trail.
13B	Seward Highway culvert	Untreated storm water outfall	A 42 in. diameter storm drain outfalls directly into Chester Creek immediately downstream of Seward Highway. This pipe drains approximately 300 acres of primarily residential land roughly bounded by and including Seward Highway, Northern Lights Boulevard, Lake Otis Boulevard, and 36th Avenue.	This project looks at the potential of constructing storm water treatment on the north side of the creek to the west of the Seward Highway. The storm drain presently outfalls directly on top of the 7 ft diameter creek culvert. The approximate invert elevation of this outfall is El 55. The approximate low point elevation of the land for storm water treatment is 55.3 ft. Therefore a direct connection of this outfall is not possible unless the storm drain outfall elevation is increased or excavation done on the north side of the creek. ADOT record drawings of the storm drain, dated 1965, show that approximately 2 ft of elevation could be gained by reconstructing 100 ft of the storm drain. This would require excavation to the centerline of the Seward Highway. ADOT drawings of the Seward Highway Rehabilitation, dated 1986, show that a petroleum separator was installed in the first manhole upstream of the outfall. This manhole could not be located visually and is apparently not serviced.	It is not recommended that storm water treatment be constructed at this location for the following reasons. The area available is small for the size of the drainage area. The storm drain basin is to the south of the creek. The potential area for treatment is to the north of the creek. This would require the storm drain to cross the creek. This can presently be done within the road fill. This would not be possible if a future bridge were constructed. A petroleum separator may already exist at this outfall. Servicing of this separator should be explored.
13C	Seward Highway culvert	Untreated storm water outfall	A 42 in. diameter storm drain outfalls directly into Chester Creek immediately downstream of Seward Highway. This pipe	This project looks at the potential of constructing storm water treatment on the south side of the creek to the west of the Seward	Construct stormwater treatment area at Chester Creek at Eagle Street and connect with 1300 ft of storm drain.

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
			drains approximately 300 acres of primarily residential land roughly bounded by and including Seward Highway, Northern Lights Boulevard, Lake Otis Boulevard, and 36th Avenue.	Highway. The existing 42 in. storm drain, which is located approximately in the center median of Seward Highway, would be turned west at 22nd Avenue. An existing 12 in. storm drain is located in 22nd Avenue and drains to an outfall into Chester Creek at Eagle Street. The 12 in. storm drain would be replaced with approximately 1300 ft of 48 in. pipe. This pipe would join the existing outfall at Eagle Street. Eagle Street in this area is a abandoned segment of road. The storm water treatment area would be constructed at the location of this road, thereby repairing this segment of the greenbelt.	
14	Channel between Seward Highway and Karluk Street	Low habitat diversity	This segment of the creek was constructed as a trapezoidal ditch. The creek is working to establish diversity.	Boulder groups installed at key locations would promote channel meandering, scour pools, and other habitat diversity. The meander pattern establishing itself below Karluk Street should be used as a placement guide for the boulder groups.	Install boulders in the creek bank. Boulders should be on alternating sides and 100 ft between groups.
14A	Karluk Street bike trail bridge	Bank erosion and channel widening.	An exposed telephone cable is causing the creek to erode the channel banks.	Relocate the cable out of or below the creek channel. Allow banks to revegetate and stabilize. Coordinate with ACS.	Relocate cable either below creek bottom or hang cable from bridge. Restore any impacted creek banks.
14B	Juneau Street storm drain	Eroding hillside under storm drain outfall	The storm drain outfall at Juneau Street originally used a half culvert pipe to convey storm water down the hillside from Juneau Street to a 24 in. pipe under a large playing field next to Chester Creek. The 24 in. pipe empties directly into	A pipe would be constructed down the upper, steep part of the hill. This would be about 150 ft long and would require filling the ravine. A stabilized open channel would be constructed from the end of the new storm drain pipe to the bottom of the hill. At the	Construct storm water treatment at Juneau Street.

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
			Chester Creek. The half pipe has not been maintained, and the storm water has jumped out of it, destroyed the pipe, and eroded a large gully in the steep hillside. The erosion is ongoing and during rain events large quantities of sediment are eroded from the gully and transported into the creek through the 24 in. pipe. This will continue to be a major source of sediment in Chester Creek until stabilized.	bottom of the hill a pond would be constructed to remove sand, gravel, and floating material from the storm water. The pond would be about 30 ft wide and 100 ft long. Storm water would be directed out the eastern end of the pond onto the existing low lying ground. The storm water would be contained between the playing field fill and the toe of the hill. It is expected that with the exception of the largest storm events, the storm water will percolate into the ground. In large storm events the water will flow east about 1000 ft to an existing culvert under the bike trail and into Chester Creek. The 24 in. pipe under the play field would be used for local drainage and potentially as a large storm event overflow.	
14C	Karluk Street greenbelt area	Greenbelt buffer reduction and installation of an additional storm drain to creek.	Private property within the greenbelt poised for subdivision development	Purchase the property or a conservation easement on the property.	Purchase development rights on property.
15	North Fork restoration	Relocate the North Fork into its original channel.	The North Fork was diverted from its existing channel in the 1960s and placed in a ditch parallel to Sitka Street. The channel still exists in the Sitka Street Park wetlands.	The MOA DPW has developed a preliminary restoration plan for this creek, dated December 1999. The restoration plan includes construction of an open channel and flood control berms and other improvements to reestablish the creek. Coordination with Merrill Field Airport and FAA will be required to address wildlife hazard issues.	Implement recommendations in the MOA December 1999 plan. Resolve the wildlife hazard issues with the airport and FAA. Resolve flooding issues at 1935 Orca Street through purchase of the property.
15A	Hillstrand Pond	Potential fish passage	The outlet culverts create a	The concrete should be removed	Remove concrete slabs and

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
	outlet	problems at pond outlet culverts.	steep section in the channel. To control erosion and help fish passage, concrete slabs have been placed downstream of the culverts. These create falls and are not placed in a manner to promote fish passage.	and replaced with a designed step-pool channel to the outlet of the culverts. The channel could be constructed from boulders. This channel should favor flow to one of the 4 culverts to promote fish passage during extreme low flow conditions. The step pool channel should create a 6 in. backwater into the culvert during lowest flow conditions.	replace with a step pool channel designed to promote fish passage toward one culvert.
15B	Hillstrand Pond	Sediment accumulation in the pond area.	The pond acts as a sediment trap in the creek. Removing the sediment appears to improve the habitat quality of creek segments downstream of the pond.	The pond could be dredged. Earlier work by MOA DPW found the sediments to be contaminated with hydrocarbons and heavy metals. The dredging proposal was dropped due to high costs of dealing with the sediments. Unless a deeper pond is desired, dredging will not be required until the pond is full, and sediment passes through the pond.	Dredge the pond of accumulated sediment.
15C	Lake Otis Parkway culverts	Fish passage problems at downstream end of culverts and creek degradation upstream of culverts.	The culverts may have been poorly set originally. A recently added fish pass at the downstream of one culvert has helped fish passage. The culverts have caused sediment to deposit upstream of them. This has filled the channel and caused it to widen.	Two alternatives are available for this location: First, a prefabricated baffle system could be installed at one of the culverts to enhance fish passage through that culvert. The selected culvert should align with the step-pool channel on the downstream end. The current fish pass should be replaced with this channel. This alternative, while workable, only addresses a portion of the problems at this site. The second, comprehensive solution would be to replace the culverts with a bridge. The creek channel could be reconstructed from below the culvert outlet to	Replace culverts with a bridge and reconstruct the stream channel with grade control. A detailed hydraulics study is required to determine the optimum channel and bridge design.

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
				above the inlets. This would allow totally unrestricted fish passage and reclaim this area as rearing habitat. The reconstructed channel would have to include bed control structures to ensure the elevation drop between the inlet and outlet channels does not cause excessive erosion. The new channel will allow sediment transport and reestablish lost habitat in the upstream channel due to aggradation. The bridge construction can be coordinated with proposed road upgrades for this segment of Lake Otis Parkway.	
16A	Middle Fork Chester Creek at Tikishla Park	Channel widening and habitat loss	Utility construction across the creek left the channel wide and flat. This is also the confluence of a ditch from the north with the Middle Fork. The combination of the confluence and in-channel work has caused the channel to widen.	Both the creek and ditch channels should be reconstructed. The creek channel should have a steep north bank added to narrow the channel to match upstream sections. The ditch should have a similar bank added to its east side. The now gravel bar area should be slightly filled and planted as a floodplain area in the creek.	Reconstruct the creek and ditch banks to increase creek and ditch depth and available habitat.
16B	Middle Fork Chester Creek drainage tributary	Fish passage blockage	The trail culvert is perched and blocks access by fish to the upper portions of the ditch. The culvert is in a drainage ditch that begins at Northern Lights Boulevard and empties into the Middle Fork. The segment downstream of this culvert is steep and may not have enough water for access by fish during summer rearing. The ditch freezes solid in the winter.	Fish use of the ditch should be established. If the channel is used, the culvert should be lowered to match the ditch grade.	Lower culvert

Appendix G. Potential Restoration Projects

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
16C	Middle Fork Chester Creek at Nichols Street	Creek is culverted	During development of this area, the Middle Fork was placed in a large pipe along Nichols Street.	The pipe is about 500 ft long and 8 to 12 ft below grade to the channel bottom. Any open channel would have 1 road and 2 driveway crossing. Unless large amounts of property were purchased for the channel, it would be deep and steep sided in order to fit into the available area. The reconstructed channel would connect the downstream channel with about 500 ft of existing open channel. Above that point, the creek is within a storm drain for about 2400 ft before it reconnects with Russian Jack Springs.	Construct open channel
16D	Middle Fork Chester Creek at Bragaw Street	Untreated storm drain input	The drainage basin at this location consists of storm drainage from approximately 1600 acres of residential area and a pristine stream, draining 300 acres of parkland (Russian Jack Springs). The flows are combined in a storm drain approximately 2400 ft upstream.	A treatment pond could be located on undeveloped land bounded by Bragaw Street, Northern Lights Boulevard, Nichols Street, and the present creek. This pond would bypass the existing creek that is presently in 500 ft of open channel and 500 ft of large pipe along Nichols Street. The elevation of the existing ground in this area varies from 6 to 11 ft higher than the existing culvert inlet. The record drawings of the storm sewers show that they are at minimum grades and cannot be raised. Therefore a pond constructed in this area would require a fairly deep excavation.	Construct treatment pond
17	Middle Fork Chester Creek at Reka Street	Undersized culverts. Bank erosion. Lack of riparian vegetation.	The creek flows between apartments and the street. Apartment driveway culverts could be enlarged to provide better flow characteristics. Creek banks are mowed to the edge of	The fish use of this reach should be established. If fish are in this reach of the stream and could use improved habitat here, improvements should be done.	Do a comprehensive fish use survey of this part of the creek. It is cut off from the main creek by 2400 ft of storm drain. Plant stream banks with riparian vegetation

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
			the water, which eliminates overhanging vegetation. The channel bottom is kept clear of woody debris so the channel lacks habitat.	This is a spring fed creek segment and shows little flow fluctuation. Enlarging the culvert is not necessary. Banks could be planted with trees and shrubs to create riparian habitat. Some in-stream structures could be added to improve channel diversity. These include boulders and logs. They need to be carefully placed to avoid causing bank damage from erosion.	vegetation. Add in-stream structure of logs and boulders.
18	South Fork Chester Creek at Northern Lights Boulevard	Backwater upstream of culvert and high velocities in culverts during high flows. Lack of habitat in culvert.	Culvert beneath Northern Lights Boulevard has less conveyance area than open channel.	Replace existing culvert with a culvert with sufficient width to match existing stream.	Culvert replacement
18	South Fork Chester Creek at Mallard Drive	Backwater upstream of culvert and high velocities in culverts during high flows. Lack of habitat in culvert.	Culvert beneath Mallard has less conveyance area than open channel.	Replace existing culvert with a culvert with sufficient width to match existing stream.	Culvert replacement
18A	South Fork Chester Creek near University Lake	Abandoned channel	This segment of channel was abandoned when the creek was diverted into University Lake and a new channel constructed to the north.	Connecting the channel to the lake was explored. The channel is higher than the lake. Since this would require pumping to put water in the channel, the project was dropped from further consideration.	
19	South Fork Chester Creek at inlet to University Lake	A large sediment delta in the lake at the creek inlet. The delta can cause fish passage problems at low flows. Eroding channel upstream of inlet.	When University Lake was constructed, Chester Creek was rerouted to the head of the lake, and was shortened and steepened. The new channel has eroded significantly as it progresses to a stable channel form. This eroded material has	To resolve the access problems, the sediment delta will be removed, and a trap will be excavated to contain future sediment from the upstream channel. The trap will be sized to hold the amount of sediment projected to erode from the banks	Excavate sediment trap at stream inlet to lake. Place boulders in the channel in the winter.

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
			deposited where Chester Creek empties into University Lake and formed a delta. The delta can cause fish passage problems at low flows because the water is wide and shallow. We estimated that about 2/3 of the meander bends in the new channel have stabilized and the remainder are still ongoing so deposition will continue. Constructing bank stabilization measures in this segment may cause more damage to the steep creek banks the leaving them to stabilize naturally. Leaving the creek to erode naturally, a stable channel is the best option for this site.	as they stabilize. An additional problem in this area is that the steep channel could be difficult for fish to ascend because it lacks resting pools. Boulder groups should be placed in this segment of the creek to provide resting places for fish. Because construction access to the channel is poor, the boulders would be placed in the winter to prevent damage to the creek and riparian area during placement.	
20	Branch of South Fork Chester Creek at College Gate Elementary School	Creek channel is wide and has a gabion wall along its west bank. A backwater is created by a grade break. Severe icing occurs downstream of the grade break.	This is the most upstream segment of this branch of the South Fork of Chester Creek that remains as open channel. This open channel section is connected to a storm drain system that drains approximately 100 acres of residential area and a portion of Northern Lights Boulevard. A 54 in. diameter storm drain empties into a 600 ft long x 40 ft wide section of manmade open channel. The channel is much wider than necessary. Water depth would be shallow except that there is a rock sill at the downstream end that creates a backwater. The creek has a steeper gradient downstream of the sill. There appears to be an icing problem at the transition at	Several levels of projects could be undertaken here. First, and simplest, would be to remove the gabions and replace them with natural bank materials. The bank could then be planted. A further level of work could transform the ponded area into a meandering channel with a low marshy floodplain. To construct this, the ponded area would be filled in to create a 10 ft wide channel that meanders through the filled floodplain. The floodplain fill would be placed within 6 in. of the normal water surface to maintain wet, marsh soil conditions. The third option would be to start about 150 ft downstream of the grade break in the channel and	Reconstruct channel

Appendix G. Potential Restoration Projects

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
			icing problem at the transition at the change in grade. Gabions were placed along the west side of the channel, presumably for construction of a parking area for the school. These gabions are unnecessary.	regrade the channel between that point and the culvert outlet. This channel would be constructed narrower and at a constant grade to promote habitat complexity and decrease channel icing.	
20A	South Fork Chester Creek at Emmanuel Street	Velocity chute at inlet of culvert	Culvert set at wrong grade	Removing the miter from the end of culvert will lower it enough to eliminate problem. Bank will need planting after cutting the culvert.	Remove mitered end of culvert and restore site.
21	South Fork Chester Creek at Vuenter Subdivision	Abandoned channel	When the creek was relocated into its present channel, this segment was abandoned. The constructed channel is 4 to 5 ft lower than the original channel.	Reconnecting the channel is not possible. The channel does not exist in the greenbelt in a form that is usable. It also has a higher bed elevation than the existing channel.	None
22	South Fork Chester Creek at Alaska Village Trailer Court	Channel encroachment and lack of riparian vegetation	This creek was moved and channeled in the 1960s to allow construction of the trailer court. The contractor maximized the use of the property and placed the creek in a narrow ditch. The creek banks are all grass covered as trees were not allowed to grow on the banks. The creek channel lacks much diversity.	Two alternatives exist for restoration projects through this reach. The first is to restore the creek in place, and the second is relocate the creek into a new channel. Restore in Place. The existing creek channel could be restored in place. The channel lacks four elements through this reach. The first is overhead cover, the second is in-stream diversity, and the third is a floodplain bench, and the last is a set-aside corridor. The corridor could be established through purchase of stream easements through this private parcel. These should be at least 50 ft either side of the stream. The floodplain bench could be constructed within this corridor and will reduce the effects of flood	Restore in Place. Purchase creek easement. Construct a floodplain bench along the creek channel. The floodplain bench should be constructed without disturbing the existing creek bank within a foot of the creek water level. Install in-stream channel diversity structures. Plant trees and shrubs in the creek corridor and near the creek. Construct New Channel. Purchase creek easement. Construct new channel within the new corridor.

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
				conditions and associated high velocities. The bench should be 15 to 20 ft wide. Channel diversity can be increased by the addition of large wood debris and boulders in the channel. These need to be designed to maintain sediment transport through the reach. Finally the riparian vegetation next to the creek should be replanted. A diverse group of species should be planted to create both shade for the creek and habitat for other wildlife. New Channel Construction. A plan exists to redevelop the trailer court into other uses. Part of the plan includes relocating the creek to the east and south of its present location. The stream would be about 25% longer. There appears to be sufficient gradient to create a longer channel without making the creek sluggish or inhibiting sediment transport. The new channel should have the same features as outlined for the restoration of existing channel. These features include adequate buffer, floodplain benches, channel diversity, and riparian vegetation.	
22A	South Fork Chester Creek at downstream end of Muldoon Road	Culverts plugged with rocks. The pipes may be partially full of sediment.	It appears that the riprap placed to protect the culvert outlet area has sloughed. The rocks now block the outlet of the culverts at the headwall. The blockage will cause sediment to accumulate in the pipes under the road.	The rocks should be removed from the outlet of the culverts. This will allow accumulated sediment to wash out of the culverts. The culverts crossing Muldoon Road have a slope of 3.8%. This is fairly steep for fish passage. The submerged outlets	Study of the culvert crossing to review fish passage requirements. Remove rocks from in front of the culverts.

Appendix G. Potential Restoration Projects

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
				may actually help fish passage because they will create a backwater in the culvert. This should be studied before a recommendation is made for this area.	
22B	Muldoon Road culvert	High water velocities in culvert create a probable fish passage barrier.	Chester Creek presently flows under the Muldoon Road in a pair of 135 ft long, 44 in. x 72 in. (5 ft equivalent diameter) culverts. Slope of these culverts is 3.7%.	Replacement of these culverts with a large culvert set on a shallower slope or a bridge would eliminate high velocity problems. This would allow totally unrestricted fish passage and would also reclaim this area as rearing habitat. Raising the outlet elevation of the culverts would also help the creek by increasing the slope in the segment of creek downstream of Muldoon Road. This project will need to be coordinated with projects 22 and 24A.	This project would replace the existing creek culverts with a new culvert at a flatter slope or a bridge.
23	South Fork Chester Creek at upstream side of Muldoon Road	Creek is under a greenhouse building and has very limited stream corridor buffer area.	Commercial development of the property has encroached on the creek buffer areas. The creek flows inside a greenhouse for about 150 ft.	The creek is within the building for approximately 150 ft. The creek could either be relocated outside and adjacent to the building or the building could be removed from over the creek. Both offer a way to increase the riparian zone around the creek.	Remove the building from over the creek.
23A	South Fork Chester Creek at upstream end of Muldoon Road	Culvert inlet is partially blocked with riprap.	Riprap used for protection of the culvert inlet has fallen in front of the culvert entrances and partially blocked them. The blockage may make fish passage difficult.	The riprap should be removed in conjunction with project 22A, removing the downstream blockage.	Remove riprap at culvert entrance in conjunction with project 22A.
24	North Branch of the South Fork Chester Creek at Rangeview	Encroachment and debris in the creek	This ditch section of the north branch of the South Fork has had no maintenance in many years. Debris has accumulated	The debris in the creek should be removed from the channel. This will improve flow and allow the creek to wash out accumulated	Remove debris from the ditch.

Appendix G. Potential Restoration Projects

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
	Trailer Court		in the channel blocking flow. This channel may offer some habitat for resident fish that could access this channel from the South Fork via the storm drain system.	sediment.	
24A	North branch of the South Fork Chester Creek at downstream side of Muldoon Road	Untreated storm water outfall	A 42 in. diameter storm drain outfalls directly into Chester Creek immediately downstream of Muldoon Road. This pipe drains approximately 150 acres of primarily residential land, roughly bounded by and including Muldoon Road, East 6th Avenue, and the Military Boundary on the east and north.	This project looks at the potential of constructing storm water treatment immediately downstream of Muldoon Road. A proposed system would treat baseflow in a lined pond and provide fish access. Since this area has very permeable soils, a infiltration system for storm flows may be possible.	Construct storm water treatment area immediately downstream of Muldoon Road.
			This storm drain also provides a connection for fish to the upper reaches of the north branch of the South Fork Chester Creek at Rangeview Trailer Court.	This project would need to be coordinated with projects 22 and 22A.	
25-26		Projects on Fort Richardson Reservation		Removed from the project list by request of Fort Richardson.	
27		Bank Stabilization Projects	Bank erosion at various locations is occurring from utility line crossings, storm drain outfalls, misplaced riprap and other man-made influences.	Stabilization at these sites can be accomplished by removing what is causing the problem, e.g., riprap removal or cutting off a protruding culvert, and stabilizing the area with vegetation or vegetation and minor bioengineering, creating a stable bank.	Construction projects may include installation of soil pillows and coir logs to promote a stable bank toe and planting vegetation for long-term stability and habitat improvement.
28		In-stream habitat improvements	In-stream habitat diversity has been reduced through earlier channelization projects. These projects reduced diversity in the channel and therefore reduced fish habitat.	In-stream habitat can be improved through addition of structures within more barren channel reaches. These structures must, however, maintain sediment transport, or they may destroy more habitat than they create. Each site should be carefully	Construction projects may include installation of habitat structures that may be appropriate. These may include bank boulder groups, bank large woody debris, floating bank cover, or other structures that do not inhibit sediment transport in the stream.

Appendix G. Potential Restoration Projects

Project	Location	Feature	Possible Cause	Possible Restoration Method	Construction Project
				analyzed to ensure the structure will work at that location.	
29		Storm water treatment improvements	Many smaller storm drains empty untreated into the creek. These carry sediment, debris, and other pollutants into the creek. In some cases, oil-grit separators exist but are deteriorated and inadequate for the volume of water received.	Terminating storm drains into pocket wetlands before they reach the creek would improve creek water quality. The wetlands may be natural or man-made and may or may not require ponds for sediment removal. The wetlands will also allow storm water to infiltrate into the ground. Infiltration will reduce flood flow peaks as well as provide groundwater for maintaining creek base flow.	Specific construction projects will depend on the burial depth of the storm drain. Shallow storm drains could be brought to the surface at the edge of Chester Creek valley and allowed to run overland to the creek. Larger storm drains will require construction of sediment and debris removal structures before the water is discharged to the surface. Deeper storm drains will require excavation and creation of wetland treatment areas prior to discharging to the creek.